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PRESSURE RESISTANT ANECHOIC COATING FOR UNDERSEA PLATFORMS

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT (1) ARTHUR C. SPERO, (2) CARLOS M. GODOY, (3) AZRIEL HARARI employees of the United States Government, and (4) JAMES M. TEAQUE, citizens of the United States of America, residents (1) Front Royal, County of Warren, Commonwealth of Virginia, (2) Middletown, County of Newport, State of Rhode Island, (3) Middletown, County of Newport, State of Rhode Island and (4) Norfolk, County of Norfolk, Commonwealth of Massachusetts, have invented certain new and useful improvements entitles as set forth above of which the following is a specification:

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3 **PRESSURE RESISTANT ANECHOIC COATING FOR UNDERSEA PLATFORMS**
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5 **STATEMENT OF GOVERNMENT INTEREST**

6 The invention described herein may be manufactured and used
7 by or for the Government of the United States of America for
8 Governmental purposes without the payment of any royalties
9 thereon or therefore.
10

11 **BACKGROUND OF THE INVENTION**

12 **(1) Field of the Invention**

13 The invention relates to anechoic composites as a coating or
14 as a component of a structural element for use on undersea
15 platforms.

16 **(2) Description of the Prior Art**

17 Presently, noise control technology for undersea vehicles
18 includes external coatings in which the coatings absorb probing
19 undersea sound waves produced by sonar transducers and thereby
20 echoes of the undersea sound waves are minimized to prevent
21 active detection of the undersea vehicles.

22 In Rauh (U.S. Patent No. 3,698,993), a foamed closed cell
23 sheet elastomeric material with particulate material distributed
24 there through is disclosed. The particulate material is composed
25 of high density particles of variegated sizes and shapes. The
26 high density particles preferably have a specific gravity and are

1 extruded. The particles are of irregular heterogeneous shape as
2 distinguished from regular geometric shapes or patterns.

3 In Fischer et al. (U.S. Patent No. 5,420,825), a composite
4 for use on submarines and surface craft for controlling self-
5 generated noise is disclosed. The composite includes two layers
6 of PVF₂ transducers separated by a layer of phase shifting or
7 absorbing material. The inner transducer senses noise from the
8 ship and subtracts this from the signal from the outer transducer
9 representing noise plus the desired signal. In a second mode,
10 the sensed noise is regenerated through the outer transducer 180
11 degrees out-of-phase to cancel the noise and allow more accurate
12 detection.

13 In Cushman et al. (U.S. Patent No. 5,400,296), an acoustic
14 attenuation and vibration damping material is disclosed.
15 Embedded within the material are high and/or low characteristic
16 acoustic impedance particles in which the particles are
17 mismatched to allow some portion of the impinging acoustic or
18 vibratory energy to be reflected.

19 In Sevik (U.S. Patent No. 5,444,668), an anechoic and
20 decoupling coating for use on an underwater structure is
21 disclosed. The coating is an elastomeric matrix containing
22 sealed air-filled cavities as well as random labyrinths of small
23 water-filled passages running throughout and in open
24 communication with a surface facing the water. Acoustic waves
25 incident upon the water-facing surface cause time varying shear
26 and bulk deformations within the matrix. As a result of these
27 deformations, acoustic energy is dissipated by hysteretic damping

1 of the elastomeric matrix as well as by viscosity due to water
2 movement to and fro within the passages and into and out of the
3 matrix.

4 In Cushman (U.S. Patent No. 5,745,434), an acoustic or
5 damping material is disclosed. The material is produced by
6 mixing at least two species of particles into the material in
7 order to produce the material with tortuous passageways. The
8 particle species are of crumb tire rubber from used tires.

9 The problem with presently used noise control technologies is
10 that their acoustic properties deteriorate due to the large
11 deformation of the rubber particles or other acoustic impedance
12 particles under the depth and shock pressures associated with
13 undersea operations. As such a composite material as a noise
14 control technology may be acceptable for sound absorption at one
15 hydrostatic pressure or temperature and less effective at
16 another. Additionally, presently used composites may collapse
17 under shock pressure due to the large shear deformation of the
18 rubber particles.

19

20 SUMMARY OF THE INVENTION

21 Accordingly, it is an object of the present invention to
22 provide an anechoic composite material that can serve as a
23 coating on a hull of an undersea vehicle.

24 It is a further object of the present invention to provide
25 a composite material for absorbing acoustic energy.

26 It is a still further object of the present invention to
27 provide a composite material for an undersea platform that

1 absorbs acoustic energy directed toward the platform from an
2 external source and thereby camouflages the existence of the
3 platform.

4 It is a still further object of the present invention to
5 provide a composite material that is resistant to deterioration
6 due to the depth and shock pressures associated with undersea
7 operations.

8 It is a still further object of the present invention to
9 provide a composite material that is potentially insensitive to
10 deterioration due to the depth and shock pressures associated
11 with undersea operations.

12 It is a still further object of the present invention to
13 provide a composite material with anechoic properties that can
14 serve as a component of a structural element of a submarine sail.

15 In order to attain the objects described, there is
16 provided a composite material composed of a syntactic foam matrix
17 with inclusions of glass spherical shells embedded in the matrix
18 in which each of the shells encapsulate a dynamically-active
19 rubber core. The glass spherical shells are acoustically
20 transparent at frequencies of interest and with their relatively
21 small wall thickness cause only a slight modification to the
22 resonance of the inclusions. The resonance of the rubber core
23 with ferrite loading in combination with the matrix material
24 dissipates acoustic energy directed toward the composite
25 material.

26 Since the spherical shells are statically stiffer than the
27 surrounding matrix material, the shells shield their encapsulated

1 cores from background pressure and thereby allow a lower shear
2 modulus for the cores. A lower shear modulus allows the use of
3 the rubber-like core. The stiffness and spherical shape of the
4 inclusions also make the composite material resistant to pressure
5 and substantially increases the shock resistance of the composite
6 material. As a result, a composite material is disclosed that
7 will dissipate the power of an incoming sea wave and is resistant
8 to undersea pressures as well as being able to dissipate acoustic
9 energy.

11 BRIEF DESCRIPTION OF THE DRAWINGS

12 A more complete understanding of the invention and many of
13 the attendant advantages thereto will be readily appreciated as
14 the same becomes better understood by reference to the following
15 detailed description when considered in conjunction with the
16 accompanying drawing wherein:

17 FIG. 1 is a cross-sectional view of the composite material
18 of the present invention.

20 DESCRIPTION OF THE PREFERRED EMBODIMENTS

21 Referring now to the drawing wherein like numerals refer to
22 like elements throughout the view, one sees that FIG. 1 depicts a
23 composite material 10 of the present invention in which the
24 composite material is contained by plates 40. The plates 40 are
25 preferably fiberglass or an alternate composite material known to
26 those skilled in the art. The combination of the plates 40 with
27 the composite material 10, shown in the figure, can be used as a

1 structural element such as a panel or shell used in the
2 construction of an undersea vehicle (not shown).

3 The composite material 10 comprises a matrix material 12
4 having inclusions 20 of spherical shells 22 in which each shell
5 encapsulates a dynamically-active core 24. The spherical shells
6 22 are preferably made of glass; however, any suitable substitute
7 known to those skilled in the art may be used.

8 The core 24 is preferably TECHTHANE or a similar material
9 known to those skilled in the art in which the core has rubber-
10 like properties and is ferrite loaded (a particle species of
11 iron). Ferrite loading or the uses other heavy loading metals
12 strengthen the core 24 and enhance the pass-through acoustic
13 qualities of the core. The rubber properties of the core 24
14 contribute to a comparatively low weight of the composite
15 material 10.

16 The matrix material 12 is preferably formed from syntactic
17 foam containing a majority of voids in which the matrix material
18 has the properties of a rigid plastic as well as a suitable
19 anechoic material. The preferred density for the syntactic foam
20 is 1.12 kg/m^3 with the bulk modulus of 2.0×10^9 Pascal. The
21 matrix material 12 along with the inclusions 20 is resistant to
22 the high depth pressures and shock pressures associated with the
23 operations of a submarine or undersea vehicle.

24 Acoustic absorption is enhanced by the maximum packing of
25 the inclusions 20 in the matrix material 12, preferably with the
26 total volume of the inclusions being greater than that of the
27 matrix material. As a construction component of an undersea

1 vehicle, the packing of the shells 22 in the matrix material 12
2 would be between the plates 40. Alternatively, the composite
3 material 10 may be spread and cured on a backing material or a
4 sheet material (not shown) as a construction component. In
5 either situation similar-sized inclusions 20 may be used to lower
6 the overall cost of the composite material 10.

7 The advantages of the present invention are that the
8 composite material 10 is relatively insensitive to changing water
9 pressure and incoming shock pressures while maintaining anechoic
10 properties.

11 There has been described one embodiment of the present
12 invention. It will be obvious that various modifications and
13 deviations may be made from this disclosure without departing
14 from the substance of the invention which is defined by and
15 limited only in the claims amended hereto.

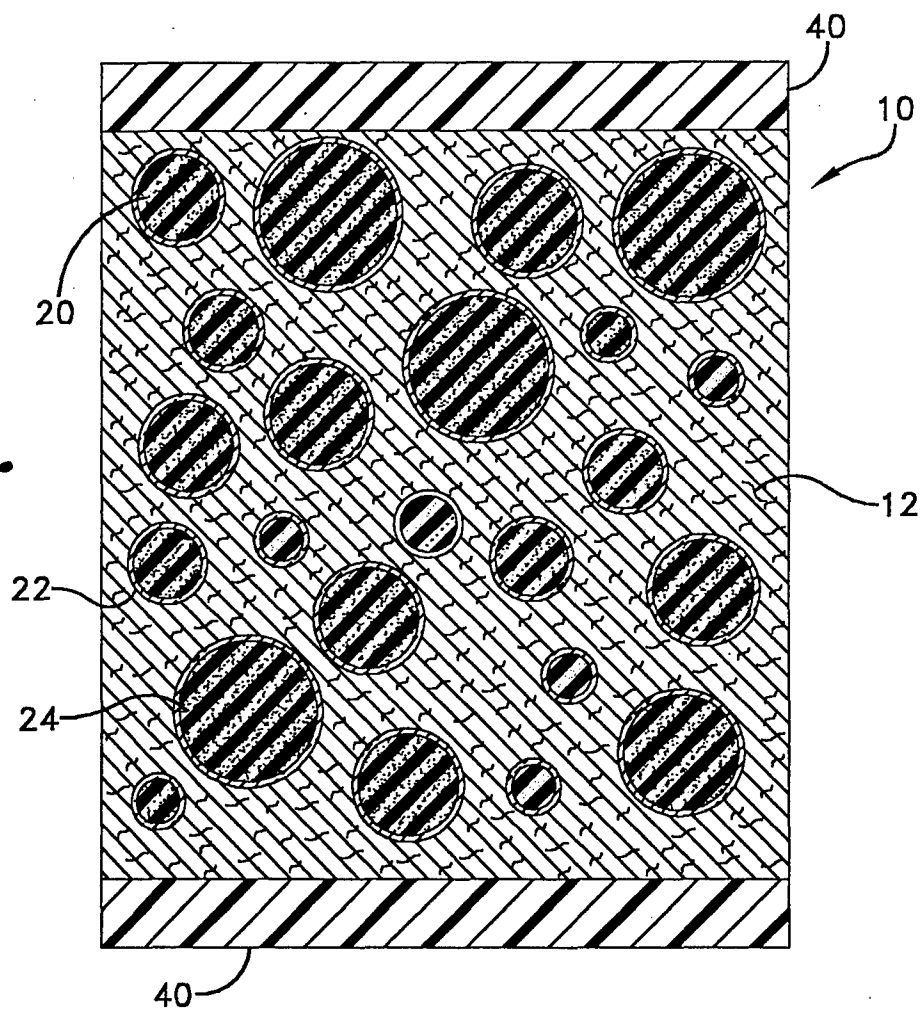


FIG. 1

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3 **PRESSURE RESISTANT ANECHOIC COATING FOR UNDERSEA PLATFORMS**

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5 **ABSTRACT OF THE DISCLOSURE**

6 A composite material containing inclusions of spherical
7 shells in which each spherical shell encapsulates a rubber core
8 with ferrite loading. The inclusions are embedded in a matrix
9 material of syntactic foam. The spherical shells are made from
10 glass and therefore acoustically transparent and in combination
11 with the cores are statically stiffer than the surrounding matrix
12 material. The composite material with the matrix material and
13 inclusions allows the composite material to be acoustically
14 dissipating with a stiffness in which the energy of forces
15 associated with undersea platforms is resisted.